

Basic Principles of Biomechanics Part 3

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Injuries are usually seen as muscle strains. These are the most common and most feared by any athlete. They may occur due to overuse, example, repetitive motion, such as pitching in baseball or due to forceful overload in a sport activity, example, hamstring strain during the launch off a plate in long jump. They are graded from grades 1 to grade 3. Here's a simple grading scale that can be used to understand and note what type of muscle strain you are dealing with.

In a grade 1 muscle strain, minor or microscopic tissue damage is noted. It is painful for the patient. They usually experience a severe cramp or spasm. It is not usually palpable. And it usually takes about 7 to 10 days for normal recovery back to 100% function. In grade 2 muscle strain, it is a moderate or macroscopic or partial thickness tear of muscle tissue. It is extremely painful for the patient. There is a muscle cramp or spasm. It is palpable by torn fibers in the muscle tissue. And rehabilitation is required for 10 to 21 days for normal recovery, usually between 80% and 100% return of normal muscle function depending on the thickness of the tear.

In grade 3 muscle strains, this is usually a severe maximal or full thickness tear of the muscle tissue. The patient usually doesn't feel much pain, initially, due to the loss of tension. It's usually a physical muscle deformity as the muscle has had a full thickness tear. The muscle sheath or fascia may still remain attached to the tendon. Surgery and rehabilitation is usually required with a three week to six month recovery.

Tendonitis or tendonosis, these are inflammatory conditions that affect the tendons directly. Most common mechanisms of injury is due to overuse or increased leverage on the tendons in sports, such as racket-based sports. Most common forms are usually tennis elbow, golfer's elbow, and jumper's knee. The grading of tendon strains is similar to that of what we saw in muscle. Take note that we again grade in a 1, 2, and 3 scale as we did with muscle. Grade 1 tendon strain is minor or microscopic tissue damage. It is usually painful for the patient, not palpable, and has a seven to 10 day recovery period, usually with non-steroidal anti-inflammatory drugs and/or compression.

In grade 2 tendon strains, it is a moderate or macroscopic effect on the tendon tissue. It is extremely painful for the patient. There is a palpable deficit in the tendon usually in the form of swelling, such as in tenosynovitis. The rehabilitation is required, and it is commonly called an enthesopathy. Grade 3 tendon strains is known as severe or maximal or full thickness tears of the tendon. It is usually associated with avulsion fractures as it's usually affected at the tendinous junction between the bone and the tendon.



Delayed Onset Muscle Soreness, or DOMS-- this is where the products of collagen breakdown from intense, rapid training may act as a chemotactic agent and inflammatory marker causing macrophages to travel into the muscle tissue and begin an inflammatory response. The macrophages are non-specific phagocytes and breakdown imperfect and normal cells thus causing tissue damage.

Hydroxyproline, or OHP, is a urine marker for early onset DOMS. If DOMS is severe enough that it effects large amounts of tissue, the degradation will be seen by rise of creatine kinase and may lead to rhabdomyolysis or other complications. Common treatments for DOMS include cryotherapy, regular stretching, ultrasound, light, low resistance exercise, hyperbaric therapy, compression, massage therapy, and drugs in the form of non-steroidal anti-inflammatory drugs.

Ligaments-- ligament physiology. The ligaments are the primary restraints and guides for the joints. They provide the main line of support for normal joint motion. They are the last line of defense for joint hyperextension and instability. They are subject to continuous loading and are most affected by the phenomenon of "creep". Creep is a physiological phenomenon where there is tissue distortion over a period of time when a constant force is applied over a long period of time. We see this in general ligament laxity when a shoulder is overused or overstretched.

Common injuries of ligaments include ligament sprains. They are commonly due to joint malposition during a weight bearing exercise. The most common version is inversion sprain of the ankle, commonly in running and in stop or start sports, such as netball or basketball. Joint hyperextension and instability, there's usually overload of the ligaments, which may induce capsular stretching. There's also joint dislocation, which is commonly in contact sports due to the force of impact. And it commonly happens in juvenile level sports where the ligaments are still stretching due to bone growth.

As seen before with muscle injury, we refer to a grade 1, grade 2, grade 3 grading system for ligament damage. In grade 1 ligament sprains, you will see minor or microscopic tissue damage. It is painful for the patient. They usually experience acute or moderate swelling and minor hematoma formation. It is not usually a palpable defect. The joints stability is usually maintained, but they may have minor instability masked by exaggerated apprehension and pain. It takes about 7 to 10 days to heal. And the weight bearing, or proprioception, is affected.

In a grade 2 ligament sprain, there is moderate or macroscopic partial thickness tearing. It is extremely painful for the patient. There is a large or significant swelling and hematoma. The muscle cramp or spasm may mask instability, but instability is seen easily with the naked eye. When the joint is placed under pressure or weight bearing, it is unbearable for the patient and proprioception is affected. Immobilization is required as soon as possible.

In a grade 3 ligament sprain, there is severe or maximal tissue tearing. The patient does not feel pain initially due to the loss of tension. There is gross joint instability, which is commonly seen and may also see repetitive joint dislocation if associated to a joint displacement. The proprioception is completely disrupted and may affect voluntary joint control. Surgery is commonly required with rehabilitation.